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(54) **Multi-purpose tyre for motor-vehicles**

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- **PATENT ABSTRACTS OF JAPAN vol. 015, no. 235 (M-1125), 17 June 1991 & JP-A-03 074208 (YOKOHAMA RUBBER CO LTD:THE), 28 March 1991,**
- **PATENT ABSTRACTS OF JAPAN vol. 014, no. 454 (M-1031), 28 September 1990 & JP-A-02 182505 (TOYO TIRE & RUBBER CO LTD), 17 July 1990,**

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Description

[0001] The present invention relates to a multi-purpose tyre for motor-vehicles.

[0002] More particularly, it pertains to the tread pattern of the tyre in question, which is particularly appropriate for tyres to be used on motor-vehicles envisaged for offering good performance both on a dry road and on a wet and even snow-covered road.

[0003] It is known that in tyres of the multi-purpose type the pattern and blend of the tread band must be conveniently studied so that they should be capable of meeting the different requirements specifically demanded with reference to the behaviour the tyre must have on the different types of road-beds for which its use is contemplated, that is not only on a dry or wet road-bed, but also on a snow-covered road-bed

[0004] These requirements are, on the other hand, in conflict with each other, so that hitherto-manufactured tyres usually represent a compromise solution among the different requirements, and in any case they never reach the performance level achieved by a tyre specifically conceived for use on a given type of road-bed, be it dry, wet or snow-covered.

[0005] Generally speaking, and leaving out of consideration the use for which it has been conceived, a good tyre must have, among other things, high features in terms of directional control and traction capability, as well as resistance to wear.

[0006] The directional control features, consisting in the tyre capability to maintain the set trajectory in a precise manner, are positively affected by the presence of longitudinal grooves, whereas the traction capability features, consisting in the tyre capability to transmit tangential forces both in accelerating and braking, are increased by arranging grooves oriented in a direction transverse to the running direction. The efficiency of these transverse grooves for traction capability purposes increases as the groove orientation approaches a direction parallel to the tyre axis, so that usually for such grooves angles included between 45° and 90° are selected.

[0007] After the above preliminary remarks, it should be noted that as regards tyres especially conceived for being run on a dry road-bed, the number and width of both longitudinal and trasverse grooves tend to be reduced so as to improve resistance to wear, running noislessness and smoothless of the tyre.

[0008] As regards running on a wet road-bed, on the contrary, a greater groove width is desired, above all with reference to the circumferential grooves the task of which is that of discharging the water gathered on the ground-contacting area of the tyre so as to avoid the occurrence of the well-known and dangerous aquaplane effect.

[0009] Finally, with reference to a running on a snow-covered road-bed, a great number of cuts or narrow grooves is required, so as to conveniently hold the snow picked up from the road-bed, because - as it is well known, a snow-on-snow friction coefficient is greater than a rubber-on-snow friction coefficient.

[0010] EP-485,883 discloses a "directional winter type tyre tread" comprising at least three circumferentially extending straight grooves which divide said tread into four circumferentially extending rows of elastomeric blocks and a plurality of zig-zag transverse shaped grooves which extend from the lateral edges towards the equatorial plane of the tyre.

[0011] Each block of the tyre tread according to EP-485,883 is provided with five lamellae (sipes) which form six small blocks of elastomeric material. Said lamellae cross each block and connect opposite sides of the parallelogram shape possesed by said blocks. For this reason, said six small blocks are reciprocally movable when the tyre contacts the ground giving a good performance on the snow covered road, but causing a remarkable wear of the tread on dry road beds.

[0012] It clearly appears from the above that many difficulties are encountered when one wishes to manufacture a multi-purpose tyre which simultaneously should meet all stated requirements which are in conflict wich each other and specifically emerge with reference to runnings on a dry, wet and snow-covered road-bed.

[0013] In fact, arrangement of the circumferential wide grooves is in contrast both with the running requirements on a dry road-bed preferring grooves of reduced sizes to increase the land portion of the tread pattern so as to improve the resistance to wear and running noiselessness of same, and with the running requirements on a snow-covered road-bed, in which case wide grooves by promoting self-cleaning of the tread pattern cause a limitation in the behavioural features of the tyre, in particular traction capability and roadholding.

[0014] The great number of cuts required for use on a snow-covered road-bed is in turn also in contrast with the running requirements on a dry road, because a too great number of cuts involves greater susceptibility to deformation of the land portions or blocks (which will bring about a noise increase and greater wear), as well as a reduction in the running stability and smoothness.

[0015] As a result, therefore, present multi-purpose tyres have a moderately good roadholding on a wet road-bed, in any case lower than that of modern tyres specifically studied for being run on a wet road-bed, a moderately good traction capability on snow, but lower that that achieved with tyres specifically studied for winter climates, as well as an acceptable resistance to wear and sufficient roadholding on a dry road-bed, however without reaching the same level as the best "summer tyres" available on the market.

[0016] In accordance with the present invention, it has been found that by making a grooved composite pattern in a tread, with a wide central channel without side outlets adapted to drain water from the ground-contacting area of the tyre under running conditions on a wet road-bed, transverse grooves adapted to ensure traction on

a dry road-bed, as well as longitudinal grooves to ensure a good directional control both on a dry and on a wet road-bed, and by making said longitudinal grooves in the form of a sequence of portions oriented obliquely to the circumferential direction as well as sipes particularly oriented and designed in combination with the transverse grooves and the tread pattern, excellent behavioural qualities are achieved either on a dry, or a wet, or a snow-covered road-bed, which qualities are surprisingly higher than those of all known multi-purpose tyres and substantially of the same level as the most modern tyres specifically studied for each of the above uses.

[0017] In more detail the invention relates to a tyre for motor-vehicles provided with a grooved tread band having a multi-purpose composite pattern, wherein said pattern comprises:

- a central straight channel, extending circumferentially at a centered position with respect to the equatorial plane of the tire;
- two series of circumferentially-distributed transverse grooves disposed at laterally-opposite positions relative to the central channel and having a substantially inclined extension, symmetrically converging towards the circumferential channel itself;
- at least two circumferential grooves symmetrically spaced apart from the central channel and delimiting, together with the transverse grooves, two rows of center blocks extending at symmetrically side-by-side positions relative to the central channel, and two rows of shoulder blocks extending adjacent to opposite side edges of the grooved composite tread pattern;
- each of said circumferential grooves being defined by a sequence of parallel portions, oriented obliquely to the circumferential direction of the grooved composite tread pattern, in order to give the groove itself a broken-line course, and each portion delimiting the mutually opposite circumferential edges of a center block and a shoulder block, so that each of said center and shoulder blocks has a corner projecting inwardly of the circumferential groove with respect to the opposite corner of the circumferentially adjacent block, said oblique portions of the two circumferential grooves converging towards the central channel in a concordant direction with the converging direction of said transverse grooves.

[0018] The tyre is characterized by the fact that:

- said central channel is defined by two continuous ribs to have two continuous edges, wherein each of the edges extend straight,
- the extension of said transverse grooves is interrupted by said continuous ribs before said transverse grooves open into the central channel;
- said circumferential ribs defining said central channel are separated from the centre blocks by respective circumferential internal boundary hollows;
- said shoulder blocks have first transverse lamellae cuts which are oriented, relative to the axial direction, in an opposite direction to the inclination offered by the transverse grooves at said shoulder blocks and substantially according to the same angle, each said lamellae cuts consisting of two transverse lamellae, respectively inner and outer circumferentially staggered relative to each other and interconnected by a lamelliform connecting cut extending in circumferential direction and crossing one of the transverse grooves so that each lamelliform cut extend over two contiguous blocks;
- said centre blocks have second lamellae cuts having the same shape as the first lamellae cuts of the shoulder blocks.

[0019] In particular, the oblique portions of the two circumferential grooves converge in mirror image relationship towards the central channel, in a concordant direction with the converging direction of said transverse grooves, forming an inclination angle included between 2° and 5° with the circumferential direction.

[0020] Preferably said central channel has a width included between 3% and 5% of the overall width of the grooved composite tread pattern, and a depth included between 6 and 10 mm, said central channel being delimited by two side walls diverging towards the external surface of the composite tread pattern according to an angle included between 3° and 12°.

[0021] In more detail, said side walls are joined to the central-channel bottom and the external surface of said composite pattern by arcs of a cercle the radius of curvature of which is included between 2 and 5 mm.

[0022] Preferably, said circumferential grooves have a width, measured perpendicularly to the longitudinal extension of said oblique portions, between 5 and 10 mm. The tranverse grooves have an increasingly growing inclination and an increasingly diminishing width towards the central channel.

[0023] In more detail, said transverse grooves each have a first portion extending at the shoulder blocks according to a given axial inclination, preferably included between 2° and 8°, and a second portion extending at the centre blocks according to an axial inclination greater than that of the first portion, preferably included between 15° and 45°.

[0024] In a preferential solution, following the first portion of each transverse groove there is an intermediate portion opening into the corresponding circumferential groove and having an axial inclination of a value included between those of the axial inclinations of the first and second portions.

[0025] It is also provided that the transverse lamellae should slightly project, each beyond the respective intersection point with the circumferential cut.

[0026] Still in accordance with a preferential embodiment of the invention, said central channel is interposed

between two continuous circumferential ribs separated from the centre blocks by respective circumferential boundary hollows of a width included between 2 mm and 2/3 of the width of the central channel.

[0027] In a further aspect, the invention relates to a tire for motor-vehicles provided with a grooved tread band having a multi-purpose composite pattern, wherein said pattern comprises:

- a central straight channel, extending circumferentially at a centered position with respect to the equatorial plane of the tire;
- two series of circumferentially-distributed transverse grooves disposed at laterally-opposite positions relative to the central channel and having a substantially inclined extension, symmetrically converging towards the circumferential channel itself;
- at least two circumferential grooves symmetrically spaced apart from the central channel and delimiting, together with the transverse grooves, two rows of center blocks extending at symmetrically side-by-side positions relative to the central channel, and two rows of shoulder blocks extending adjacent to opposite side edges of the grooved composite tread pattern;
- each of said circumferential grooves being defined by a sequence of parallel portions, oriented obliquely to the circumferential direction of the grooved composite tread pattern, in order to give the groove itself a broken-line course, and each portion delimiting the mutually opposite circumferential edges of a center block and a shoulder block, so that each of said center and shoulder blocks has a corner projecting inwardly of the circumferential groove with respect to the opposite corner of the circumferentially adjacent block, said oblique portions of the two circumferential grooves converging towards the central channel in a concordant direction with the converging direction of said transverse grooves;

characterized by the fact that:

- said tread band is made of a blend containing at least 15 parts by weight (for one hundred parts of rubber) of siliceous reinforcing filling;
- the shape of at least one of the geometric features comprising width, depth and orientation of the grooves and cuts of said composite patterns is defined depending on the amount of sillceous filling incorporated into said blend wherein:
  - said central channel is defined by two continuous ribs and has a width of between 3% to 5% of overall width of the grooved composite tread pattern and a depth between 6 mm and 10 mm;
  - each of said circumferential groove has a width included between 5 mm and 10 mm;
  - each of said oblique portions of the circumferential grooves forms an angle between 2° and 5° with the circumferential direction of the tyre;
  - each of said said transverse groove has a width included between 3 mm and 8 mm.

[0028] From some tests carried out by the Applicant, it has come out that this siliceous filling is preferably lower than 75 parts, preferably included between 15 and 50 parts, and most preferably restricted between 15 and 25 parts.

[0029] Further features and advantages will become more apparent from the detailed description of a preferred but non-exclusive embodiment of a tyre for motor-vehicles provided with a multi-purpose grooved tread according to the present invention, taken hereinafter, by way of non-limiting example, with reference to the accompanying drawings, in which:

- Fig. 1 is a plan view of a circumferential portion of the grooved composite tread pattern in reference;
- Fig. 2 is a fragmentary transverse sectional view, to an enlarged scale, of the grooved composite pattern shown in Fig. 1, taken at the central channel thereof;
- Fig. 3 is a table reproducing the results of comparative tests concerning running on a dry road-bed, carried out on a tyre provided with a grooved tread pattern as in Fig. 1 and compared with other known tyres;
- Fig. 4 is a table reproducing behavioural tests on a wet road-bed, carried out on a tyre provided with a grooved tread pattern as in Fig. 1 and compared with other known tyres;
- Fig. 5 is a graph obtained from comparative tests adapted to verify the aquaplane phenomenon on a bend;
- Fig. 6 is a table reproducing the results of comparative behavioural tests on a snow-covered road-bed, performed on the inventive tyre compared with other known tyres.

[0030] Referring particularly to Fig. 1, a tread pattern of the multi-purpose type for motor-vehicle tyres grooved according to the present invention has been generally identified by reference numeral 1.

[0031] The tread band, preferably made of a blend of elastomeric material containing a reinforcing filling of siliceous material in an amount included between 15 and 25 parts by weight for one hundred parts of rubber, has a central channel 2 extending circumferentially in a centered position to the equatorial tyre plane, denoted by axis "X" in Fig. 1 and having a depth "H" included between 6 and 10 mm, preferably of 8 mm.

[0032] Preferentially, as shown in Fig. 2, the central channel 2 is delimited between two side walls 2a diverging towards the external surface "S" of the composite tread pattern 1 according to an angle "α" included between 6° and 24°, preferably of 16°. The side walls 2a

are joined to the channel bottom 2b and the external surface "S" by internal and external arcs of a circle "R1" and "R2" respectively, the radius of curvature of which has a value included between 2 and 5 mm.

[0033] In a preferential solution, the value of radius "R1" for the internal arcs of a circle is provided to be equal to 2.7 mm, whereas the value of the radius of curvature "R2" for the external arcs of a circle is provided to correspond to 4 mm.

[0034] In addition, the central channel 2 has a width, identified by "l" and delimited by the intersection points of the side wall "2a" projections with the surface "S", which is preferably included between 3% and 5% of the overall width "L" of the composite tread pattern. By way of example, for a tread pattern adapted to a tyre of size 175/70 R 13 in which the overall width "L" of the composite tread pattern is 195 mm, the width "l" of the central channel preferably corresponds to 7 mm.

[0035] The composite tread pattern 1 further has two series of transverse grooves 3 distributed circumferentially at laterally-opposite positions relative to the central channel 2, as well as at least two circumferential grooves 4 spaced apart symmetrically from the centre line of the central channel 2 (equatorial plan "X") by a distance "d" included between 25 mm and 40 mm, preferably corresponding to 30 mm.

[0036] The transverse 3 and longitudinal 4 grooves preferably have the same width as the central channel 2 and define two rows of rhomboidal centre blocks 5 on the surface "S" of the composite tread pattern, which centre blocks extend at symmetrically side-by-side positions relative to the central channel 2, and two rows of shoulder blocks 6, of substantially rhomboidal shape too, which extend along the opposite side edges 7 of the composite tread pattern.

[0037] The shoulder blocks 6 are separated from the side edges 7 7 by circumferential continuous external boundary hollows 9 preferably of a lower width than the transverse grooves 3.

[0038] Advantageously, the transverse grooves 3 disposed respectively on opposite sides relative to the central channel 2, have a substantially inclined extension, symmetrically converging towards the circumferential channel itself, the angle of which becomes increasingly wider towards said channel.

[0039] In more detail, each transverse groove 3 has a first portion 3a extending at the shoulder blocks 6 according to a predetermined axial inclination "β1", and a second portion 3b extending at the centre blocks 5 with an axial inclination "β2" greater than the axial inclination of the first portion 3a.

[0040] In more detail, with reference to the first portion 3a, the axial inclination, that is angle "β1" formed by said portion with a trajettory "Y" parallel to the tyre axis, that is perpendicular to the equatorial plan "X", is provided to be included between 2° and 8°, and preferably to correspond to 4°30'. The axial inclination of the second portion 3b is in turn included between 15° and 45° and preferably is 25°.

[0041] It is also provided that the first portion 3a of each transverse groove 3 be followed by an intermediate portion 3c opening into the corresponding circumferential groove 4 and having an axial inclination of a value included between those of the axial inclinations "β1" and "β2" of the first and second portions 3a, 3b.

[0042] Advantageously, the extension of the transverse grooves 3 is interrupted before said grooves open into the central channel 2, by a pair of continuous circumferential ribs 8 delimiting the central channel on respectively opposite sides and having a rounded outline by effect of the arcs of the external circles "R2". Such circumferential ribs 8 preferably are separated from the centre blocks 5 by respective inner-delimitation circumferential hollows 8a, of a depth "h" (Fig. 2) included between 2 mm and 2/3 of the DEPTH of the central channel 2, preferably in the order of 2-3 mm, and a width included between 1.5 and 2.5 mm, preferably equal to 1.8 mm.

[0043] In an original manner, as clearly shown in Fig. 1, each circumferential groove 4 is defined by a sequence of parallel portions 4a oriented obliquely to the circumferential direction, so as to give a broken-line course to the groove itself.

[0044] As can be seen from Fig. 1, each portion 4a delimits the respectively opposite circumferential edges of one of the centre blocks 5 and one of the shoulder blocks 6, so that each centre block 5 and shoulder block 6 has a corner 5a, 6a projecting inwardly of the circumferential groove 4 with respect to the opposite corner 5b, 6b of the circumferentially adjacent block 5, 6.

[0045] It is provided to advantage that the inclined portions 4a of the circumferential grooves 4 should converge in mirror image relationship towards the central channel 2, in a direction concordant with the converging direction of the transverse grooves 3, so that the projection of blocks 5, 6 is defined by an acute angle at the respective corners 5a, 6a.

[0046] More particularly, each inclined portion 4a of the longitudinal grooves 4 forms an angle of inclination "α" included between 2° and 5°, and preferably of 3°, with the circumferential direction of the tyre.

[0047] The width "W" of each circumferential groove 4, measured at right angles to the longitudinal extension direction of each oblique portion 4a, is included between 5 and 10 mm, and preferably corresponds to 7 mm.

[0048] Still in accordance with the present invention, the shoulder blocks 6 have first lamelliform cuts 10, each of which is formed of a sequence of cuts 10a, 10b, usually referred to as "lamellae" or "fins", of a depth smaller by about 1 mm than that of the longitudinal 4 and transverse 3 grooves. More particularly, each lamelliform cut 10 has an inner transverse lamella 10a and an outer transverse lamella 10b parallel to each other and circumferentially spaced apart, interconnected by a circumferential cut 10c, about 1 mm deep, extending parallelly to the circumferential direction of the tyre.

[0049] As viewed from Fig. 1, each circumferential cut

10c crosses one of the transverse grooves 3, preferably at the passage point between the first portion 3a and the intermediate portion 3c, so that each lamelliform cut 10 extends over two contiguous blocks 6.

[0050] The transverse lamellae 10a, 10b are advantageously inclined, with reference to the axial direction Y, in an opposite direction to the transverse grooves 3, preferably according to an angle "δ" of a value close to or equal to angle "β1" formed by the first portions 3a of said transverse grooves.

[0051] It is also provided that the transverse lamellae 10a, 10b should slightly project beyond their intersection point with the circumferential cut 10c.

[0052] In a preferential solution, the outer transverse lamellae 10b have an end portion 10d disposed in the extension of the lamella itself and crossing the external-delimitation hollow 9; this end portion 10d has a length included between 7 mm and 10 mm and preferably of 8 mm, and a width included between 1.5 and 2.5 mm, preferably of 2 mm.

[0053] Second lamelliform cuts 11 are also present. They are formed on the centre blocks 5 and shaped in the same manner as the first lamelliform cuts 10. In more detail, each lamelliform cut 11 has an inner transverse lamella 11a and an outer transverse lamella 11b, oriented according to said angle "δ" and mutually interconnected by a circumferential connecting cut 11c extending through the second portion 3b of the corresponding transverse groove 3.

[0054] According to a further feature of the present invention, the transverse grooves 3 have an increasingly growing width as they move away from the central channel 2. More particularly, the width "V1" of the transverse grooves 3 at the first portions 3b is provided to be included between 3 mm and 8 mm, and preferably it varies from a minimum value of 3 mm to a maximum value of 8 mm, moving away from the central channel 2. The detectable width "V2" at the first portions 3a, and at the intermediate portions 3c of the transverse grooves 3 is in turn included between 4 mm and 8 mm, and is at least constant but preferably increasingly growing, moving away from the central channel 2.

[0055] From the above description, it is possible to see that the presence of the large central channel 2 and the circumferential grooves 4 gives the composite tread pattern 1 a high water-draining capability and therefore an excellent resistance to the aquaplane phenomenon.

[0056] It should be noted that the negative effects due to the projection of the block corners 5a, 6b inwardly of the circumferential grooves 5, that should adversely affect the water drainage from the ground-contacting area of the tyre, are surprisingly eliminated in that they are efficiently compensated for by the fact that the central channel 2, as it is delimited between the continuous ribs 8, is completely devoid of side outlets and therefore all the water gathered at the central region of the ground-contacting area is pushed along the channel itself with a high pressure ensuring a quick evacuation of same. The water gathered at the tyre shoulders is, on the contrary, evacuated by virtue of the angular variation in the axial direction of the transverse grooves 3, as well as the arrangement of same converging in a mirror image towards the central channel 2.

[0057] The siliceous material filling used in the blend of the tread band also helps in improving the tyre adhesion, above all on a wet road; in addition, the orientation of the transverse grooves 3 which approaches the axial direction close to the edges 7 of the tread pattern, helps in improving the traction capability on every type of road-bed, which traction capability is further enhanced by the inclination of the oblique portions 4a forming the longitudinal grooves 4. In fact, corners 5a, 6a of blocks 5, 6 projecting inwardly of the circumferential grooves 4 substantially behave like a series of teeth exerting an efficient grip either on a dry, or a wet, or a snow-covered road. In case of running on a snow-covered road-bed, the projecting corners 5a, 6a efficiently hold the snow, thereby improving the traction capability and adhesion even under these conditions.

[0058] Adhesion on the snow is further increased by the presence of the siliceous material as the reinforcing filling in the blend froming the tread band.

[0059] In this connection it has been found that the use of siliceous material in a given amount, as the reinforcing filling in the blend, has by itself the effect of increasing the grip features of the blend on a wet and snow-covered ground and therefore it advantageously integrates with the geometrical features of the inventive pattern, compensating for disadvantages and emphasizing the advantages connected with such features; more particularly, at least one of the features comprising shape, width, depth and inclination of the grooves and cuts in the tread pattern, is defined, within the above mentioned variability ranges, depending on the quantity of the siliceous material incorporated into the blend, so as to maximize the synergistic effect between the geometric features of the pattern and the physical features of the blend for the purpose of achieving the intended results.

[0060] For example, the negativeness of a specific width or of some grooves' orientation in respect of traction capability or roadholding can be advantageously compensated for by an approriate amount of siliceous filling; this amount, always greater than 15 parts by weight for one hundred parts of rubber, is preferably lower than 75 parts, more preferably included between 15 and 50 parts and most preferably restricted to 15-25 parts.

[0061] In particular, the use of the siliceous material available on the market from the known company DEGUSSA under the commercial name "ULTRASIL VN3" has been found convenient.

[0062] The mirror orientation of the transverse grooves 3 gives the tyre a tread pattern of a clearly directional type, wherein the preferring rolling direction is the one marked by arrow "F" in Fig. 1, leading the trans-

verse grooves 3 to enter the ground-contacting area of the tyre starting from their axially internal end. Advantageously, the presence of the lamelliform cuts 10, 11, involving transverse lamellae 10a, 10b, 11a, 11b oriented according to an opposite angle to that of the transverse grooves 3, ensures maintenance of an excellent grip on the road-bed even during a braking operation, when the tangential forces are directed in the opposite direction to that normally imposed by the torque, with reference to which the rolling direction "F" is allocated.

[0063] Reproduced in Figs. 3 to 6 are the results obtained from different comparative tests carried out on a prototype tyre provided with a grooved tread pattern according to the above description, as compared with other tyres available on the market.

[0064] In more detail, with reference to tables shown in Figs. 3 and 4. columns identified by 1, 2, 3 and 4 refer to the test results achieved on the following tyre types, respectively:

- column 1 = a Pirelli tyre "P 2000" particularly conceived for use on a dry road-bed;
- column 2 = a known tyre provided with a central channel, particularly suggested for use on a wet road-bed;
- column 3 = a known tyre specifically typified as "Energy", that is of the "low-rolling-resistance type";
- column 4 = a prototype tyre having a carcass corresponding to that of a Pirelly tyre P 2000, with a tread containing 20% of the siliceous filling and a composite tread pattern made in accordance with the present invention.

[0065] In all tests, tyres had the following sizes: 175/65 R 14.

[0066] Referring particularly to Fig. 3, the table therein shown reproduces the results achieved after driving tests on a track, on a dry road-bed, carried out with reference to behavioural qualities.

[0067] Rows A, B, C, D, E, F, G, H reproduced therein represent scores obtained by the individual tyres with reference to the following entries, respectively:

A = directional running control on a straight stretch;
B = steering stiffness;
C = response quickness to steering;
d = progressive rate of response to steering;
E = direction stability on a bend;
F = insertion quickness on a bend;
G = transverse yielding;
H = ride comfort.

[0068] The awarded scores, on a 1 to 10 scale, show the obtained judgement with reference to the different aspects considered during the test, i.e. the better the results the higher the awarded score.

[0069] As can be seen from the table shown in Fig. 3, the behaviour of the tyre having the composite tread pattern according to the invention, with reference to a running on a dry road-bed, is substantially in line with the behaviour of the tyre (Pirelli "P 2000") having the same carcass structure and in which the composite tread pattern has been specifically studied for running on a dry road-bed, the results of which are reproduced in column 1. It is possible to note that the tyre referred to in column 2, expressly conceived for enhancing performance on a wet road-bed, has quite lower behavioural features with reference to the test on a dry road-bed.

[0070] In the table in Fig. 4, referred to the running behaviour on a wet road-bed, rows A, B, C represent respectively:

A = control capability;
B = responsiveness to aquaplane phenomenon
C = traction capability.

[0071] From said table one can see that the tyre in reference has obtained, in all respects, higher average scores than those of all other tyres tested. Only the tyre referred to in column 2, expressly studied for use on a wet road-bed, has a better behaviour specifically referred to the aquaplane phenomenon.

[0072] Graph in Fig. 5 shows the performance of the tested tyres with reference to how they behave under aquaplane conditions on a bend.

[0073] More particularly, shown on the y-axis is the transverse acceleration achieved, in m/s^2, depending on the running speed, reproduced on the x-axis in Km/h, on a bend.

[0074] Marked by 1, 2, 3 and 4 are the curves respectively obtained by the tyres referred to in columns 1, 2, 3 and 4 in the tables shown in Figs. 3, 4.

[0075] From this graph it is apparent that the tyre provided with the tread pattern in reference, shown by curve 4, has a better behaviour than the three other tested tyres, above all at relatively high speeds, due both to the higher transverse acceleration borne, and the higher speed achieved before the complete "aquaplane", that is a bearable transverse acceleration corresponding to zero.

[0076] Table shown in Fig. 6 reproduces the scores obtained by tyres in a test for checking behaviour of same on a snow-covered road-bed.

[0077] Referring to this table, columns 1, 2, 3 and 4 respectively relate to:

- column 1 = the known tyre referred to in column 2 in tables 3 and 4, particularly envisaged for use on a wet road-bed;
- column 2 = a known tyre specifically conceived for the so-called "All-Season" use;
- column 3 = Pirelly tyre "P 2000", particularly envisaged for being run on a dry road-bed;
- column 4 = a prototype tyre having the same carcass as tyre "P 2000", with a tread containing 20% of siliceous filling and a grooved composite pattern

made according to the present invention.

[0078] Rows A, B, C, D, E, F, G reproduce scores referred to the following behavioural aspects, respectively:

A = traction capability under pickup conditions (starting friction);
B = traction capability under running conditions (dynamic friction);
C = directional stability on a straight stretch;
D = side roadholding on a bend;
E = braking under grip conditions (unlocked wheels, active ABS);
F = braking under skidding conditions (locked wheels, inactive ABS);
G = driving power on pick-up.

[0079] From said table it clearly appears that the tyre provided with a grooved tread according to the invention has, from all the examined points of view, an excellent running behaviour on a snow-covered road-bed, not only with undoubtedly higher results than those of the tyres referred to in columns 1 and 3, envisaged for a wet and a dry road-bed respectively, but, surprisingly, also with higher results with reference to those in column 2, concerning a tyre specifically studied for "All-Season" use, and therefore openly of the winter type.

[0080] It is therefore apparent that the present invention has enabled different planning features to be integrated in the composite tread pattern, each of said features taken by itself being negative versus at least one of the different tyre behaviours (since it is positive only versus one particular behaviour alone) in such a synergistic combination that an exclusively positive overall result is achieved, that is equal to or better than the result found in known tyres, taking into account any behavioural aspect on a road.

[0081] Obviously, many modifications and variations may be made to the invention as conceived, all of them falling within the scope of the annexed claims.

[0082] In particular, the dimensional parameters referring to the groove width have been allocated with reference to a prototype tyre on the circumferential extension of which four different block-arrangemet pitches are alternated (the block-arrangement pitch being represented by the circumferential extension of a block and the groove adjacent thereto), combined with each other to define a given "pitch sequence" of the tread.

[0083] Therefore, the groove sizes can undergo modifications with respect to the previously described values, even depending on the number of the foreseen pitches, which number in the composite tread pattern in reference may vary between 2 and 4.

Claims

1. A tire for motor-vehicles provided with a grooved tread band having a multi-purpose composite pattern, wherein said pattern comprises:

   - a central straight channel (2), extending circumferentially at a centered position with respect to the equatorial plane ("X") of the tire;
   - two series of circumferentially-distributed transverse grooves (3) disposed at laterally-opposite positions relative to the central channel (2) and having a substantially inclined extension, symmetrically converging towards the circumferential channel itself;
   - at least two circumferential grooves (4) symmetrically spaced apart from the central channel (2) and delimiting, together with the transverse grooves (3), two rows of center blocks (5) extending at symmetrically side-by-side positions relative to the central channel (2), and two rows of shoulder blocks (6) extending adjacent to opposite side edges (7) of the grooved composite tread pattern;
   - each of said circumferential grooves (4) being defined by a sequence of parallel portions (4a), oriented obliquely to the circumferential direction of the grooved composite tread pattern (1), in order to give the groove itself a broken-line course, and each portion delimiting the mutually opposite circumferential edges of a center block (5) and a shoulder block (6), so that each of said center (5) and shoulder (6) blocks has a corner (5a, 6a) projecting inwardly of the circumferential groove (4) with respect to the opposite corner (5b, 6b) of the circumferentially adjacent block (5, 6), said oblique portions (4a) of the two circumferential grooves (4) converging towards the central channel (2) in a concordant direction with the converging direction of said transverse grooves (3);

   characterized by the fact that:

   - said central channel is defined by two continuous ribs (8) to have two continuous edges, wherein each of the edges extend straight,
   - the extension of said transverse grooves is interrupted by said continuous ribs before said transverse grooves open into the central channel;
   - said circumferential ribs (8) defining said central channel (2) are separated from the centre blocks (5) by respective circumferential internal boundary hollows (8a);
   - said shoulder blocks have first transverse lamellae cuts (10) which are oriented, relative to the axial direction, in an opposite direction to

the inclination offered by the transverse grooves (3) at said shoulder blocks (6) and substantially according to the same angle, each said lamellae cuts (10) consisting of two transverse lamellae, respectively inner (10a) and outer (10b) circumferentially staggered relative to each other and interconnected by a lamelliform connecting cut (10c) extending in circumferential direction and crossing one of the transverse grooves (3) so that each lamelliform cut (10c) extend over two contiguous blocks;

- said centre blocks (5) have second lamellae cuts(11) having the same shape as the first lamellae cuts (10) of the shoulder blocks (6).

2. A tyre according to claim 1, **characterized in that** each oblique portion (4a) of the circumferential grooves (4) forms an inclination angle included between 2° and 5° with the circumferential direction.

3. A tyre according to claim 1, **characterized in that** said circumferential grooves (4) have a width ("W"), measured perpendicularly to the longitudinal extension of said inclined portions (4a), included between 5 mm and 10 mm.

4. A tyre according to claim 1, **characterized in that** said central channel (2) has a width ("I") included between 3% and 5% of the overall width ("L") of the grooved composite tread pattern (1).

5. A tyre according to claim 1, **characterized in that** said central channel (2) has a depth ("H") included between 6 and 10 mm.

6. A tyre according to claim 1, **characterized in that** said central channel (2) is delimited by two side walls (2a) diverging towards the external surface ("S") of the composite tread pattern according to an angle ("α") included between 6° and 24°.

7. A tyre according to claim 1, **characterized in that** said side walls (2a) are joined to the central-channel bottom (2b) and the external surface ("S") of said composite tread pattern by arcs of a cercle ("R1", "R2") the radius of curvature of which is included between 2 and 5 mm.

8. A tyre according to claim 1, **characterized in that** said tranverse grooves (3) have an increasingly growing axial inclination towards the central channel (2).

9. A tyre according to claim 8, **characterized in that** said transverse grooves (3) each have a first portion (3a) extending at the shoulder blocks (6) according to a given axial inclination ("β1") and a second portion (3b) extending at the centre blocks (5) according to an axial inclination ("β2") greater than the axial inclination ("β1") of the first portion (3a).

10. A tyre according to claim 8, **characterized in that** said transverse grooves (3) have an increasingly growing width as they move away from the central channel (2).

11. A tyre according to claim 9, **characterized in that** the axial inclination ("β1") of said first portion (3a) is included between 2° and 8°.

12. A tyre according to claim 9, **characterized in that** the axial inclination ("β2") of said second portion (3b) is included between 15° and 45°.

13. A tyre according to claim 9, **characterized in that** following the first portion (3a) of each transverse groove (3) there is an intermediate portion (3c) opening into the corresponding circumferential groove (4) and having an axial inclination of a value included between those of the axial inclinations ("β1", "β2") of the first and second portions (3a, 3b).

14. A tyre according to claim 1, **characterized in that** said transverse lamellae (10a, 10b) slightly project each beyond the respective intersection point with the circumferential cut (10c).

15. A tyre according to claim 1, **characterized in that** the DEPTH of the circumferential internal boundary hollows (8a) is included between 2 mm and 2/3 of the DEPTH of the central channel and the width of said boundary hollows (8a) is included between 1,5 mm and 2,5 mm.

16. A tyre according to claim 1, **characterized in that** said tread band is made of a blend of elastomer material containing a reinforcing filling of siliceous material in an amount included between 15 and 25 parts by weight for one hundred parts of rubber.

17. A tire for motor-vehicles provided with a grooved tread band having a multi-purpose composite pattern, wherein said pattern comprises:

- a central straight channel (2), extending circumferentially at a centered position with respect to the equatorial plane ("X") of the tire;
- two series of circumferentially-distributed transverse grooves (3) disposed at laterally-opposite positions relative to the central channel (2) and having a substantially inclined extension, symmetrically converging towards the circumferential channel itself;
- at least two circumferential grooves (4) symmetrically spaced apart from the central channel (2) and delimiting, together with the trans-

verse grooves (3), two rows of center blocks (5) extending at symmetrically side-by-side positions relative to the central channel (2), and two rows of shoulder blocks (6) extending adjacent to opposite side edges (7) of the grooved composite tread pattern;

- each of said circumferential grooves (4) being defined by a sequence of parallel portions (4a), oriented obliquely to the circumferential direction of the grooved composite tread pattern (1), in order to give the groove itself a broken-line course, and each portion delimiting the mutually opposite circumferential edges of a center block (5) and a shoulder block (6), so that each of said center (5) and shoulder (6) blocks has a corner (5a, 6a) projecting inwardly of the circumferential groove (4) with respect to the opposite corner (5b, 6b) of the circumferentially adjacent block (2), said oblique portions (4a) of the two circumferential grooves (4) converging towards the central channel (2) in a concordant direction with the converging direction of said transverse grooves (3);

characterized by the fact that:

- said tread band is made of a blend containing at least 15 parts by weight (for one hundred parts of rubber) of siliceous reinforcing filling;
- the shape of at least one of the geometric features comprising width, depth and orientation of the grooves and cuts of said composite patterns is defined depending on the amount of siliceous filling incorporated into said blend wherein:
  - said central channel is defined by two continuous ribs (8) and has a width ("l") of between 3% to 5% of overall width ("L") of the grooved composite tread pattern (1) and a depth (H) between 6 mm and 10 mm;
  - each of said circumferential groove (4) has a width (W) included between 5 mm and 10 mm;
  - each of said oblique portions (4a) of the circumferential grooves (4) forms an angle σ between 2°and 5° with the circumferential direction of the tyre;
  - each of said said transverse groove (3) has a width included between 3 mm and 8 mm.

Patentansprüche

1. Reifen für Kraftfahrzeuge, der mit einem Nuten aufweisenden Laufflächenband versehen ist, welches ein Mehrzweck-Verbundmuster aufweist, wobei dieses Muster

- einen zentralen geraden Kanal (2), der sich am Umfang in einer zentrierten Position bezüglich der Äquatorialebene (X) des Reifens erstreckt,
- zwei Reihen von am Umfang verteilten Quernuten (3), die in seitlich gegenüberliegenden Postitionen bezüglich des zentralen Kanals (2) angeordnet sind und eine im wesentlichen geneigte Erstreckung mit symmetrischem Konvergieren zu dem Umfangskanal selbst haben, und
- wenigstens zwei Umfangsnuten (4) aufweist, die symmetrisch im Abstand von dem zentralen Kanal (2) angegordnet sind und zusammen mit den Quernuten (3) zwei Reihen von Mittenblökken (5), die sich an symmetrisch Seite an Seite befindlichen Positionen bezüglich des zentralen Kanals (2) erstrekken, und zwei Reihen von Schulterblöcken (6) begrenzen, die sich angrenzend an gegenüberliegende Seitenränder (7) des mit Nuten versehenen Verbundlaufflächenmusters erstrekken,
- wobei jede der Umfangsnuten (4) durch eine Folge von parallelen Abschnitten (4a) gebildet wird, die schräg zu der Umfangsrichtung des mit Nuten versehenen Verbundlaufflächenmusters (1) ausgerichtet sind, um der Nut selbst einen Verlauf mit gebrochener Linie zu geben,
- wobei jeder Abschnitt die wechselseitig gegenüberliegenden Umfangsränder eines Mittenblocks (5) und eines Schulterblocks (6) begrenzt, so daß jeder Mittenblock (5) und jeder Schulterblock (6) eine Ecke (5a, 6a) hat, die von der Umfangsnut (4) bezüglich der gegenüberliegenden Ecke (5b, 6b) des am Umfang benachbarten Blocks (5, 6) nach innen vorspringt, und
- wobei die schrägen Abschnitte (4a) der beiden Umfangsnuten (4) zu dem zentralen Kanal (2) in einer Richtung konvergieren, die mit der konvergierenden Richtung der Quernuten (3) übereinstimmt,

dadurch gekennzeichnet,

- daß der zentrale Kanal von zwei fortlaufenden Rippen (8) gebildet wird, so daß er zwei fortlaufende Ränder hat, wobei jeder der Ränder sich gerade erstreckt,
- daß die Erstreckung der Quernuten durch die fortlaufenden Rippen unterbrochen wird, bevor die Quernuten in den zentralen Kanal münden,
- daß die den zentralen Kanal (2) begrenzende Umfangsrippen (8) von den Mittenblöcken (5) durch entsprechende am Umfang befindliche innere Begrenzungsrinnen (8a) getrennt werden,
- daß die Schulterblöcke erste dünne Quereinschnitte (10) haben, die bezüglich der Axialrich-

tung in entgegengesetzte Richtung zur Neigung, die durch die Quernuten (3) an den Schulterblöcken (6) aufgeboten wird und im wesentlichen entsprechend dem gleichen Winkel ausgerichtet sind, wobei jeder der dünnen Einschnitte (10) aus zwei dünnen Quereinschnitten, nämlich einem inneren (10a) und einem äußeren (10b) besteht, die am Umfang zueinander versetzt und miteinander durch einen dünnen verbindenden Einschnitt (10c) verbunden sind, der sich in Umfangsrichtung erstreckt und eine der Quernuten (3) kreuzt, so daß sich jeder dünne Einschnitt (10c) über zwei benachbarte Blöcke erstreckt, und

- die Mittenblöcke (5) zweite dünne Einschnitte (11) mit der gleichen Form wie die ersten dünnen Einschnitte (10) der Schulterblöcke (6) haben.

2. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** jeder schräge Abschnitt (4a) der Umfangsnuten (4) einen Neigungswinkel zwischen 2° und 5° mit der Umfangsrichtung bildet.

3. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** die Umfangsnuten (4) eine senkrecht zur Längserstreckung der geneigten Abschnitte (4a) gemessene Breite (W) zwischen 5 mm und 10 mm haben.

4. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** der zentrale Kanal (2) eine Breite (1) zwischen 3% und 5% der Gesamtbreite (L) des mit Nuten versehenen Verbundlaufflächenmusters (1) hat.

5. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** der zentrale Kanal (2) eine Tiefe (H) zwischen 6 und 10 mm hat.

6. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** der zentrale Kanal (2) von zwei Seitenwänden (2a) begrenzt wird, die zu der Außenfläche (S) des Verbundlaufflächenmusters entsprechend einem Winkel α zwischen 6° und 24° divergieren.

7. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** die Seitenwände (2a) mit dem Boden (2b) des zentralen Kanals und der Außenfläche (S) des Verbundlaufflächenmusters durch Bögen eines Kreises (R1, R2) verbunden sind, dessen Krümmungsradius zwischen 2 und 5 mm liegt.

8. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** die Quernuten (3) eine zunehmend anwachsende axiale Neigung zum zentralen Kanal (2) hin haben.

9. Reifen nach Anspruch 8, **dadurch gekennzeichnet, daß** jede Quernut (3) einen ersten Abschnitt (3a), der sich an den Schulterblöcken (6) entsprechend einer vorgegebenen axialen Neigung (β1) erstreckt, und einen zweiten Abschnitt (3b) hat, der sich an dem Mittenblock (5) entsprechend einer axialen Neigung (β2) erstreckt, die größer ist, als die axiale Neigung (β1) des ersten Abschnitts (3a).

10. Reifen nach Anspruch 8, **dadurch gekennzeichnet, daß** die Quernuten (3) eine zunehmend wachsende Breite haben, wenn sie sich von dem zentralen Kanal (2) entfernen.

11. Reifen nach Anspruch 9, **dadurch gekennzeichnet, daß** die axiale Neigung (β1) des ersten Abschnitts (3a) zwischen 2° und 8° liegt.

12. Reifen nach Anspruch 9, **dadurch gekennzeichnet, daß** die axiale Neigung (β2) des zweiten Abschnitts (3b) zwischen 15° und 45° liegt.

13. Reifen nach Anspruch 9, **dadurch gekennzeichnet, daß** auf den ersten Abschnitt (3a) einer jeden Quernut (3) ein Zwischenabschnitt (3c) folgt, der in die entsprechende Umfangsnut (4) mündet und eine axiale Neigung mit einem Wert hat, der zwischen denen der axialen Neigungen (β1, β2) des ersten und zweiten Abschnitts (3a, 3b) liegt.

14. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** die dünnen Quereinschnitte (10a, 10b) jeweils leicht über den entsprechenden Kreuzungspunkt mit dem in Umfangsrichtung verlaufenden Einschnitt (10c) vorstehen.

15. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** die Tiefe der am Umfang befindlichen inneren Begrenzungsrinnen (8a) zwischen 2 mm und 2/3 der Tiefe des zentralen Kanals liegt, und daß die Breite der Begrenzungsrinne (8a) zwischen 1,5 mm und 2,5 mm beträgt.

16. Reifen nach Anspruch 1, **dadurch gekennzeichnet, daß** das Laufflächenband aus einer Mischung eines elastomeren Materials hergestellt ist, das einen verstärkenden Füllstoff eines siliciumdioxidhaltigen Materials in einer Menge zwischen 15 und 25 Gewichtsteilen pro 100 Teilen Kautschuk enthält.

17. Reifen für Kraftfahrzeuge, der mit einem Nuten aufweisenden Laufflächenband versehen ist, welches ein Mehrzweck-Verbundmuster aufweist, wobei dieses Muster

- einen zentralen geraden Kanal (2), der sich am Umfang in einer zentrierten Position bezüglich der Äquatorialebene (X) des Reifens erstreckt,
- zwei Reihen von am Umfang verteilten Quer-

nuten (3), die in seitlich gegenüberliegenden Postitionen bezüglich des zentralen Kanals (2) angeordnet sind und eine im wesentlichen geneigte Erstreckung mit symmetrischem Konvergieren zu dem Umfangskanal selbst haben, und

- wenigstens zwei Umfangsnuten (4) aufweist, die symmetrisch im Abstand von dem zentralen Kanal (2) angeordnet sind und zusammen mit den Quernuten (3) zwei Reihen von Mittenblöcken (5), die sich an symmetrisch Seite an Seite befindlichen Positionen bezüglich des zentralen Kanals (2) erstrekken, und zwei Reihen von Schulterblöcken (6) begrenzen, die sich angrenzend an gegenüberliegende Seitenränder (7) des mit Nuten versehenen Verbundlaufflächenmusters erstrekken,
- wobei jede der Umfangsnuten (4) durch eine Folge von parallelen Abschnitten (4a) gebildet wird, die schräg zu der Umfangsrichtung des mit Nuten versehenen Verbundlaufflächenmusters (1) ausgerichtet sind, um der Nut selbst einen Verlauf mit gebrochener Linie zu geben,
- wobei jeder Abschnitt die wechselseitig gegenüberliegenden Umfangsränder eines Mittenblocks (5) und eines Schulterblocks (6) begrenzt, so daß jeder Mittenblock (5) und jeder Schulterblock (6) eine Ecke (5a, 6a) hat, die von der Umfangsnut (4) bezüglich der gegenüberliegenden Ecke (5b, 6b) des am Umfang benachbarten Blocks (5, 6) nach innen vorspringt, und
- wobei die schrägen Abschnitte (4a) der beiden Umfangsnuten (4) zu dem zentralen Kanal (2) in einer Richtung konvergieren, die mit der konvergierenden Richtung der Quernuten (3) übereinstimmt,

dadurch gekennzeichnet,

- daß das Laufflächenband aus einer Mischung besteht, die wenigstens 15 Gewichtsteile (für 100 Teile Kautschuk) eines siliciumdioxidhaltigen Füllstoffs enthält,
- daß die Form wenigstens eines der geometrischen Merkmale, nämlich Breite, Tiefe und Ausrichtung der Nuten und Einschnitte der Verbundmuster abhängig von der Menge des siliciumdioxidhaltigen Füllstoffs bestimmt wird, der in der Mischung eingeschlossen ist, wobei
- der zentrale Kanal von zwei fortlaufenden Rippen (8) gebildet wird und eine Breite (I) zwischen 3% und 5% der Gesamtbreite (L) des mit Nuten versehenen Verbundlaufflächenmustes (1) und eine Tiefe (H) zwischen 6 mm und 10 mm hat,
- jede Umfangsnut (4) eine Breite (W) zwischen 5 mm und 10 mm hat,
- jeder der schrägen Abschnitte (4a) der Umfangsnuten (4) einen Winkel (δ) zwischen 2° und 5° mit der Umfangsrichtung des Reifens bildet und
- jede Quernut (3) eine Breite zwischen 3 mm und 8 mm hat.

Revendications

1. Bandage pneumatique pour véhicules à moteur, pourvu d'une bande de roulement rainurée ayant une sculpture composite multi-usage, ladite sculpture comprenant :

   - une cannelure centrale rectiligne (2) s'étendant sur la circonférence dans une position centrée par rapport au plan équatorial ("X") du bandage pneumatique ;
   - deux séries de rainures transversales (3) réparties sur la circonférence, disposées dans des positions latéralement opposées par rapport à la cannelure centrale (2) et s'étendant d'une manière sensiblement inclinée, convergeant d'une façon symétrique vers la cannelure circonférentielle elle-même ;
   - au moins deux rainures circonférentielles (4) espacées de façon symétrique par rapport à la cannelure centrale (2) et délimitant, conjointement avec les rainures transversales (3), deux rangées de blocs centraux (5) s'étendant dans des positions juxtaposées d'une façon symétrique par rapport à la cannelure centrale (2), et deux rangées de blocs d'épaulement (6) s'étendant au voisinage immédiat des bords latéraux opposés (7) de la sculpture composite rainurée de la bande de roulement ;
   - chacune desdites rainures circonférentielles (4) étant définie par une suite de parties parallèles (4a), orientées d'une manière oblique par rapport à la direction circonférentielle de la sculpture composite rainurée (1) de la bande de roulement, afin de donner à la rainure elle-même une forme en ligne brisée, et chaque partie délimitant les bords circonférentiels mutuellement opposés d'un bloc central (5) et d'un bloc d'épaulement (6), de façon que chacun desdits blocs central (5) et d'épaulement (6) ait un coin (5a, 6a) faisant saillie vers l'intérieur de la rainure circonférentielle (4) par rapport au coin opposé (5b, 6b) du bloc (5, 6) adjacent dans la direction circonférentielle, lesdites parties obliques (4a) des deux rainures circonférentielles (4) convergeant vers la cannelure centrale (2) dans une direction concordante avec la direction de convergence desdites rainures transversales (3) ;

caractérisé en ce que :

- ladite cannelure centrale est définie par deux nervures continues (8) pour avoir deux bords continus, chacun des bords s'étendant d'une manière rectiligne ;
- lesdites rainures transversales sont interrompues par lesdites nervures continues avant que lesdites rainures transversales ne débouchent dans la cannelure centrale ;
- lesdites nervures circonférentielles (8) définissant ladite cannelure centrale (2) sont séparées des blocs centraux (5) par des creux respectifs (8a) formant des limites internes sur la circonférence ;
- lesdits blocs d'épaulement ont des premières découpes en lamelles transversales (10) orientées, par rapport à la direction axiale, dans une direction opposée à l'inclinaison présentée par les rainures transversales (3) au niveau desdites blocs d'épaulement (6) et sensiblement suivant le même angle, chacune desdites découpes en lamelles transversales (10) étant constituée par deux lamelles transversales, respectivement intérieure (10a) et extérieure (10b) en quinconce dans la direction circonférentielle l'une par rapport à l'autre et reliées l'une à l'autre par une découpe lamelliforme de liaison (10c) s'étendant dans la direction circonférentielle et croisant l'une des rainures transversales (3) de façon que chaque découpe lamelliforme (10c) s'étende par dessus deux blocs contigus ;
- lesdits blocs centraux (5) ont des deuxièmes découpes en lamelles (11) ayant la même forme que les premières découpes en lamelles (10) des blocs d'épaulement (6).

2. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** chaque partie oblique (4a) des rainures circonférentielles (4) forme avec la direction circonférentielle un angle d'inclinaison compris entre 2° et 5°.

3. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** lesdites rainures circonférentielles (4) ont une largeur ("W"), mesurée perpendiculairement à l'extension longitudinale desdites parties inclinées (4a), comprise entre 5 mm et 10 mm.

4. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** ladite cannelure centrale (2) a une largeur ("I") comprise entre 3% et 5% de la largeur globale ("L") de la sculpture composite rainurée (1) de bande de roulement.

5. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** ladite cannelure centrale (2) a une profondeur ("H") comprise entre 6 et 10 mm.

6. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** ladite cannelure centrale (2) est délimitée par deux parois latérales (2a) divergeant vers la surface extérieure ("S") de la sculpture composite de bande de roulement suivant un angle ("α") compris entre 6° et 24°.

7. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** lesdites parois latérales (2a) sont réunies au fond (2b) de la cannelure centrale et à la surface extérieure ("S") de ladite sculpture composite de bande roulement par des arcs de cercle ("R1", "R2") dont le rayon de courbure est compris entre 2 et 5 mm.

8. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** lesdites rainures transversales (3) ont une inclinaison axiale croissante vers la cannelure centrale (2).

9. Bandage pneumatique selon la revendication 8, **caractérisé en ce que** lesdites rainures transversales (3) ont chacune une première partie (3a) s'étendant au niveau des blocs d'épaulement (6) suivant une inclinaison axiale donnée ("β1") et une deuxième partie (3b) s'étendant au niveau des blocs centraux (5) suivant une inclinaison axiale ("β2") supérieure à l'inclinaison axiale ("β1") de la première partie (3a).

10. Bandage pneumatique selon la revendication 8, **caractérisé en ce que** lesdites rainures transversales (3) ont une largeur croissance à mesure qu'elles s'éloignent de ladite cannelure centrale (2).

11. Bandage pneumatique selon la revendication 9, **caractérisé en ce que** l'inclinaison axiale ("β1") de la première partie (3a) est comprise entre 2° et 8°.

12. Bandage pneumatique selon la revendication 9, **caractérisé en ce que** l'inclinaison axiale ("β2") de ladite deuxième partie (3b) est comprise entre 15° et 45°

13. Bandage pneumatique selon la revendication 9, **caractérisé en ce que**, à la suite de la première partie (3a) de chaque rainure transversale (3), se trouve une partie intermédiaire (3c) débouchant dans la rainure circonférentielle correspondante (4) et ayant une inclinaison axiale d'une valeur comprise entre celles des inclinaisons axiales ("β1", "β2") des première et deuxième parties (3a, 3b).

14. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** chacune desdites lamelles

transversales (10a, 10b) se prolonge légèrement au-delà du point d'intersection respectif avec la découpe circonférentielle (10c).

15. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** la profondeur des creux (8a) formant des limites internes sur la circonférence est comprise entre 2 mm et 2/3 de la profondeur de la cannelure centrale et la largeur desdits creux (8a) formant limites est comprise entre 1,5 mm et 2,5 mm.

16. Bandage pneumatique selon la revendication 1, **caractérisé en ce que** ladite bande de roulement est constituée par un mélange de matière élastomère contenant une charge de renforcement en matière siliceuse à raison de 15 à 25 parties en poids pour cent parties de caoutchouc.

17. Bandage pneumatique pour véhicules à moteur, pourvu d'une bande de roulement rainurée ayant une sculpture composite multi-usage, ladite sculpture comprenant :

- une cannelure centrale rectiligne (2) s'étendant sur la circonférence dans une position centrée par rapport au plan équatorial ("X") du bandage pneumatique ;
- deux séries de rainures transversales (3) réparties sur la circonférence, disposées dans des positions latéralement opposées par rapport à la cannelure centrale (2) et s'étendant d'une manière sensiblement inclinée, convergeant d'une façon symétrique vers la cannelure circonférentielle elle-même ;
- au moins deux rainures circonférentielles (4) espacées de façon symétrique par rapport à la cannelure centrale (2) et délimitant, conjointement avec les rainures transversales (3), deux rangées de blocs centraux (5) s'étendant dans des positions juxtaposées d'une façon symétrique par rapport à la cannelure centrale (2), et deux rangées de blocs d'épaulement (6) s'étendant au voisinage immédiat des bords latéraux opposés (7) de la sculpture composite rainurée de la bande de roulement ;
- chacune desdites rainures circonférentielles (4) étant définie par une suite de parties parallèles (4a), orientées d'une manière oblique par rapport à la direction circonférentielle de la sculpture composite rainurée (1) de la bande de roulement, afin de donner à la rainure elle-même une forme en ligne brisée, et chaque partie délimitant les bords circonférentiels mutuellement opposés d'un bloc central (5) et d'un bloc d'épaulement (6), de façon que chacun desdits blocs central (5) et d'épaulement (6) ait un coin (5a, 6a) faisant saillie vers l'intérieur de la rainure circonférentielle (4) par rapport au coin opposé (5b, 6b) du bloc (5, 6) adjacent dans la direction circonférentielle, lesdites parties obliques (4a) des deux rainures circonférentielles (4) convergeant vers la cannelure centrale (2) dans une direction concordante avec la direction de convergence desdites rainures transversales (3);

caractérisé en ce que :

- ladite bande de roulement est constituée par un mélange contenant au moins 15 parties en poids (pour cent parties de caoutchouc) de charge de renforcement siliceuse ;
- la forme d'au moins un des reliefs géométriques, comprenant la largeur, la profondeur et l'orientation des rainures et des découpes desdites sculptures composites, est définie en fonction de la quantité de charge siliceuse incorporée dans ledit mélange, sachant que :

  - ladite cannelure centrale est définie par deux nervures continues (8) et a une largeur ("l") comprise entre 3% et 5% de la largeur globale ("L") de la sculpture composite rainurée (1) de bande de roulement et une profondeur (H) comprise entre 6 mm et 10 mm ;
  - chacune desdites rainures circonférentielles (4) a une largeur (W) comprise entre 5 mm et 10 mm ;
  - chacune desdites parties obliques (4a) des rainures circonférentielles (4) forme avec la direction circonférentielle du bandage pneumatique un angle σ compris entre 2° et 5° ;
  - chacune desdites rainures transversales (3) a une largeur comprise entre 3 mm et 8 mm.

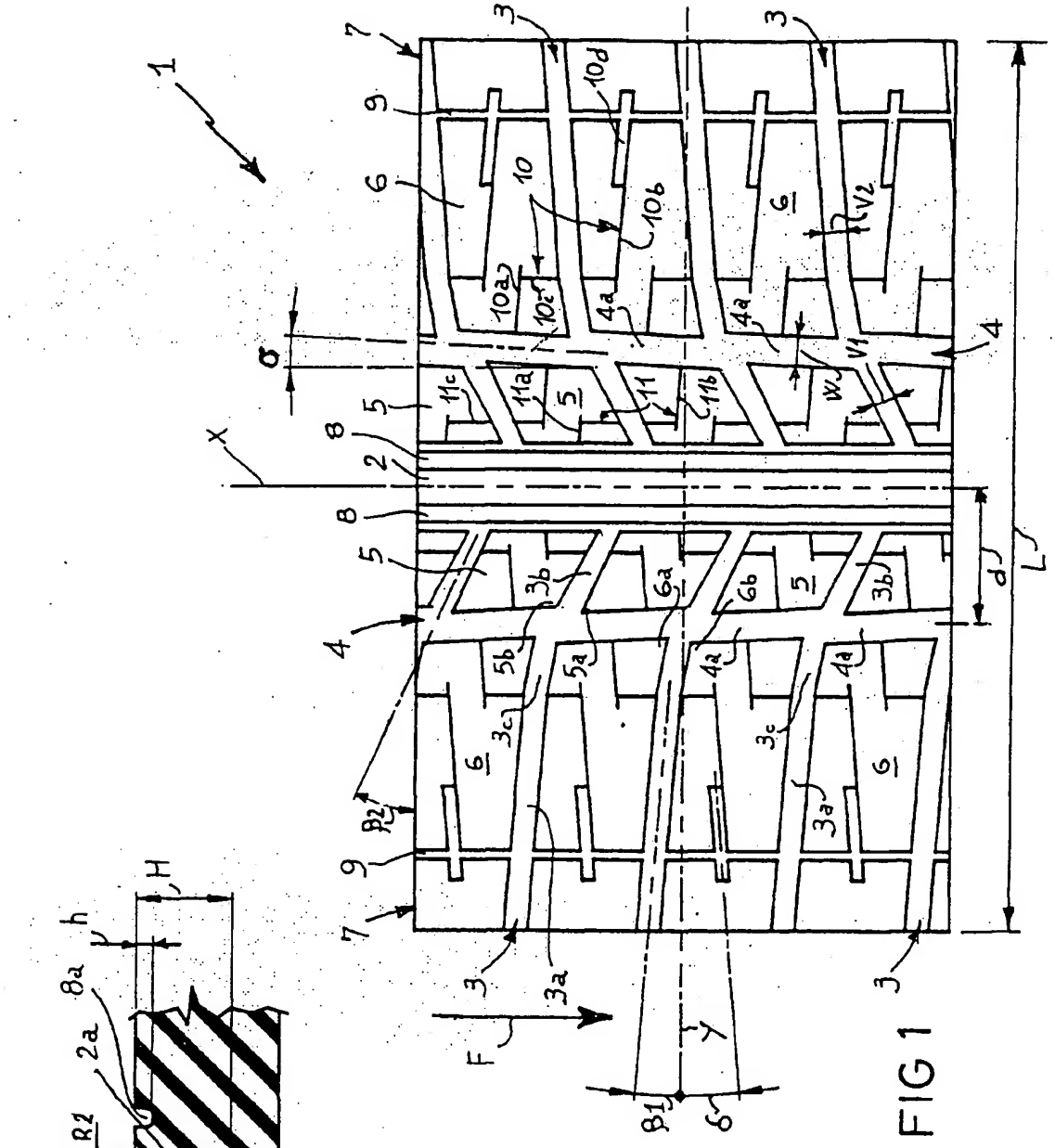
1
7
3
9
10d
6
10
10b
10a
10c
4a
σ
11c
11a
5
11
11b
W1
V1
V2
4
X
8
2
d
L
3b
6a
6b
5b
5a
3c
3a
B2
B1
F
Y

FIG 1

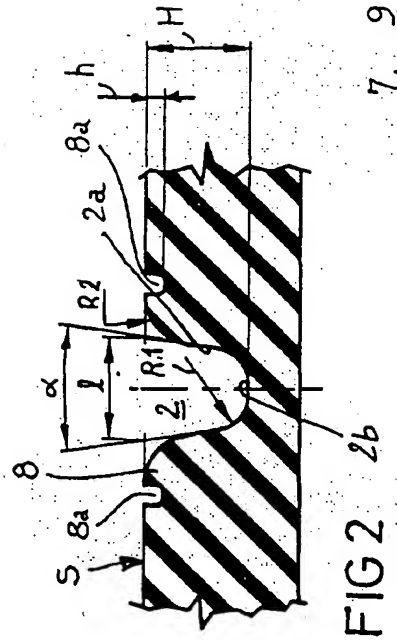
H
h
8a
2a
R2
R1
α
l
2
2b
8
5

FIG 2

	1	2	3	4
A	7	5	7	7
B	6 1/2	5	7	6 1/2
C	6 1/2	5	7	6
D	6 1/2	5	6 1/2	6
E	7	5	7	6 1/2
F	6	5 1/2	6 1/2	6 1/2
G	6 1/2	5 1/2	6	7
H	6 1/2	7	6 1/2	6

FIG 3

FIG 6

	1	2	3	4
A	6	6 1/2	6 1/2	7 1/2
B	6	6 1/2	6	7 1/2
C	6-	7	6	8
D	6	6 1/2	6	7 1/2
E	6-	6 1/2	6-	7 1/2
F	6	6 1/2	6	8
G	6	6 1/2	6-	7 1/2

FIG 5

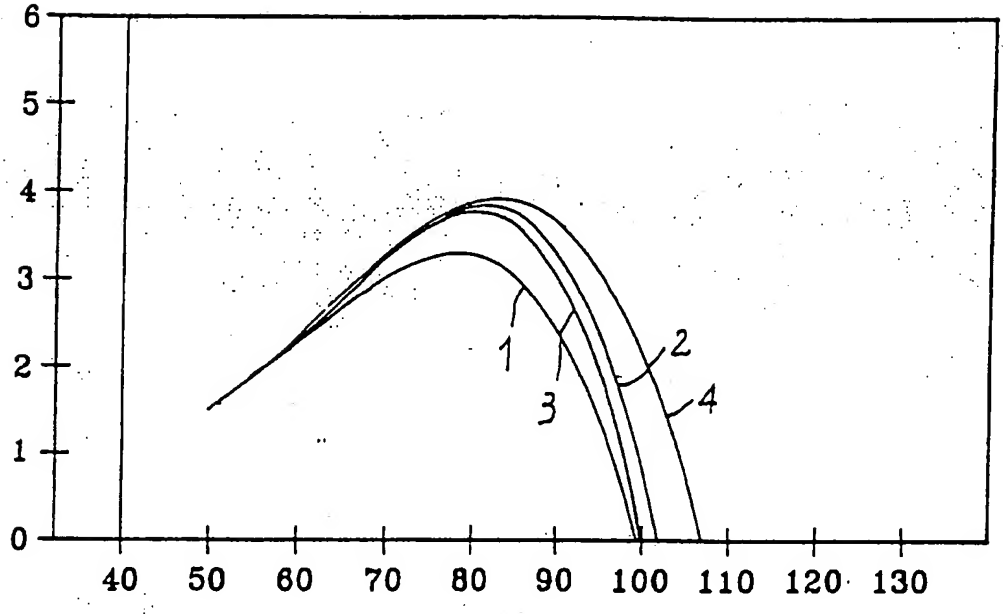

FIG 4

	1	2	3	4
A	5 1/2	4 1/2	6	6
B	6	7	6	6 1/2
C	5 1/2	4	6	6 1/2